PAPER TAPE NO. 12984-16001
series 1611

HP 12984A
LINE PRINTER SUBSYSTEM
DIAGNOSTIC

for

hp-2767A LINE PRINTER/ 12653A INTERFACE

reference manual

HEWLETT **hp** *PACKARD*

TABLE OF CONTENTS

LIST OF TABLES

Section I

INTRODUCTION

1-1. GENERAL

This diagnostic checks the operation of the HP 12984A Line Printer Subsystem which includes the HP 2767A Line Printer and HP 12653A Line Printer Interface. The subsystem may be used with any of the HP 2100 Series Computers. The line printer and the data processing circuits of the interface will be tested in addition to the basic I/O portion of the interface, which includes the Flag and Control circuits. This diagnostic aids the operator in detecting any component that has failed.

The diagnostic is run in conjunction with the 2100 Diagnostic Configurator. The general hardware/software environment and system configuration procedures are described in the HP 2000 Computer Systems Diagnostic Configurator Reference Manual. Part numbers appear in paragraph 1-3.

1-2. REQUIRED HARDWARE

The following hardware is required:

An HP 2100 Series Computer with at least 4K of memory.

An HP 12984A Line Printer Subsystem consisting of the HP 2767A Line Printer and HP 12653A Line Printer Interface Kit.

A paper tape reading device (for loading only).

Optional: a console teleprinter device for message reporting during the standard sequence of tests. If the Operator Design section (appendix A) is to be run, the console teleprinter is required.

1-3. REQUIRED SOFTWARE

The following software is required:

Diagnostic Configurator Product No. 24296A used for equipment configuration and as a console device driver.

Binary object tape   Part No. 24296-60001
Manual   Part No. 02100-90157

HP 12984A Line Printer Subsystem Diagnostic binary object tape, Part No. 12984-16001.

Note: The Diagnostic Serial Number (DSN) for the line printer subsystem diagnostic, which resides in memory location 126 (octal), is 105101 (octal).

Section II

PROGRAM ORGANIZATION

2-1. ORGANIZATION

This diagnostic program consists of five tests plus an Initialization and Control section. A sixth test (Operator Design) is described in appendix A. Tests Ø through 4 are the standard test sequence. Operator Design must be specifically selected to be executed. The Initialization and Control sections accept the select code and options required by the tests. The tests are called into execution by the Control section as sequential or selectable subroutines. The tests are named as follows:

Basic I/O (Flag and Interrupt logic) - Test ØØ (octal).

Manual Control - Test Ø1 (octal).

Paper Handling and Cyclic Print - Test Ø2 (octal).

Illegal Operations - Test Ø3 (octal).

Alignment - Test Ø4 (octal).

Operator Design - Test Ø5 (octal). (appendix A.)

2-2. TEST CONTROL AND EXECUTION

The diagnostic outputs a title message to the console device for operator information and then executes the tests according to the options selected on the Switch Register. The Control section primarily checks Switch Register bits 15, 13, and 12.

The diagnostic also keeps count of the number of passes that have been completed and will output the pass count at the completion of each pass (if Switch Register bit 1Ø is clear). The count will be reset only if the diagnostic is restarted.

Test sections are executed one after the other in each diagnostic pass. User selection or default will determine which test sections will be executed. (Refer to paragraph 2-3.)

2-3. TEST SELECTION

The operator has the capability of selecting his own tests or sequences of tests with the help of bit 9 in the Switch Register. Test selections are made after the diagnostic has been configured and one pass has been made through the standard sequence of tests. Paragraph 3-5 outlines test selections.

2-4. MESSAGE REPORTING

There are two types of messages output for diagnostics: error and information. Error messages are used to inform the operator when the subsystem fails to respond to a given control or sequence. Information messages are used to inform the operator of the progress of the diagnostic or to instruct the operator to perform operations related to the function of the subsystem. In the latter case, an associated halt will occur to allow the operator time to perform the function. The operator must then press RUN. If a console device is used, the printed message will be preceded by an E (error) or H (information) and a number (in octal). The number is also related to the halt code when a console device is not available. Examples of error and information messages are as follows: (Specific meanings are listed in section IV.)

Example - Error with halt

        Message: E030 L.P. TIME OUT
        Halt Code: 102030 (octal) (T-register or Memory
                                    Data Register)

Example - Information with halt

        Message: H024 PRESS PRESET (EXT & INT), RUN
        Halt Code: 102024 (octal)

Example - Information only

        Message: H025 BI-O COMP
        Halt Code: None

Error messages can be suppressed by setting Switch Register bit 11 and error halts can be suppressed by setting Switch Register bit 14. This is useful when looping on a single section that has several errors.

Information messages are suppressed by setting Switch Register bit 10.

Operator intervention is suppressed by setting Switch Register bit 8 (i.e., Preset Test in BI-0). When Switch Register bit 12 is set the tests that are selected will be repeated, and all operator intervention will be suppressed.

2-5.   DIAGNOSTIC LIMITATIONS

Interface capability for receiving, passing, and denying priority (priority string logic) is not completely checked by this diagnostic. If the interface does not receive priority (i.e., PRH from the next lower select code) an error E014 NO INT will occur. To check this, remove an interface of a lower select code and run the Basic I/O test. The above mentioned error should occur. Checking the interface's ability to pass or deny priority is beyond the scope of this diagnostic. Also, the Direct Memory Access (DMA) or Dual Channel Port Controller (DCPC), as it is referred to in 21MX Series Computers, portion of the interface is not tested by this diagnostic.

This diagnostic checks line printer status prior to each line of characters being transferred to the printer rather than each character. If the 2767A Line Printer is taken off-line while a line of characters is being transferred, the interface will "hang-up" and the diagnostic will report a time-out error (E030). For this reason, whenever a time-out occurs, the diagnostic checks status and, if the printer is off-line, reports L.P. Not Ready (E031) immediately following the time-out.

Section III

OPERATING PROCEDURE

3-1. LOADING AND CONFIGURING

First the Diagnostic Configurator is loaded and configured, then this diagnostic is loaded. The Configuration section of this diagnostic must be completed according to instructions that follow, prior to execution. The operator is required to input the channel (I/O select code) of the interface. All related I/O instructions in the diagnostic are then configured to the specified channel select code.

3-2. LOADING BINARY TAPES

Load the Diagnostic Configurator binary object tape. If it is a configured version, proceed with paragraph 3-3; otherwise, configure the program according to the HP 2000 Computer Systems Diagnostic Configurator Reference Manual, part no. 02100-90157.

The operator may dump a configured Diagnostic Configurator binary object tape at this point using the Configurator Dump routine.

Load this diagnostic's binary object tape. At this point, a binary tape of the combined configurator and diagnostic may be dumped using the Configurator Dump routine, otherwise a dump may be accomplished after this diagnostic is configured.

3-3. CONFIGURING THE DIAGNOSTIC

If a preconfigured diagnostic binary tape was loaded, proceed with paragraph 3-4; otherwise, load the P-register with starting address 100 (octal).

Load the Switch Register with the select code of the interface under test, (bits 0 through 5). Press PRESET (INT/EXT) and press RUN. The computer will run and then halt with 102074 (octal) in the Memory Data Register (MDR). If halt 102073 (octal) occurs the select code input was less than or equal to 7 (octal). Correct the select code and press RUN.

At this point the operator may dump a copy of the configured diagnostic to paper tape. The Configurator Reference Manual has Configurator Dump routine operating instructions. If this is done, the operator must set the P-register equal to 2000 (octal) before continuing to the next section.

3-4.   RUNNING THE DIAGNOSTIC

If a preconfigured tape was loaded or the dump routine was used, set the P-register equal to 2000 (octal) if not, do not modify the P-register.

Make a selection of Switch Register options according to table 3-1. If bit 12 is set it causes the diagnostic to loop. Bit 13, when set, is used to loop on a given test running at the time. Bit 15, if set, will halt the computer at the completion of a test. After making a selection press PRESET (INT/EXT) and press RUN. The program will then execute the diagnostic according to the Switch Register options. At the completion of each pass of the diagnostic the pass count is output to the console for operator information. If Switch Register bit 12 was not selected the computer will halt with 102077 (octal) in the Memory Data Register. At this point, the A-register contains the pass count. The operator can press RUN to execute another pass.

3-5.   OPERATOR TEST SELECTION

The Control portion of the program provides the operator with a method to select a single test, or sequence of tests to be run. The operator sets Switch Register bit 9 to indicate that a selection is desired. If the computer is halted press RUN. The computer will come to a halt 102075 (octal) to indicate - ready for selection. If the diagnostic is running, the test in progress will be completed, then the program will halt. After the halt, the operator may load the A-register with the test selections. Bit 0 of the A-register represents Test 00, bit 1 represents Test 01, and so on through bit 5, which represents Test 05 (octal). (Refer to table 3-2.) If the operator clears all bits of the A-register, the standard sequence will be run. The operator must then clear Switch Register bit 9 and press RUN. The operator-selected test(s) will then be run.

Table 3-1. Switch Register Options

BIT	MEANING IF SET
0	Reserved
1	Reserved
2	Reserved
3	Reserved
4	Reserved
5	Reserved
6	Reserved
7	Reserved
8	Suppress tests requiring operator intervention.
9	Abort current diagnostic execution and halt (102075); the user may specify a new group of tests in the A-register. Then clear bit 9 and press RUN.
10	Suppress non-error messages.
11	Suppress error messages.
12	Repeat all selected tests after diagnostic run has completed without halting. Message "PASS XXXXXX" will be output before looping unless bit 10 is set or a teletype is not present. Also, those tests requiring operator intervention will be suppressed.
13	Repeat last test executed (loop on test).
14	Suppress error halts.
15	Halt (102076) at the end of each test; the A-register will contain the test number in octal.

Table 3-2. Test Selection Summary

A-REGISTER BIT	IF SET WILL EXECUTE
Ø	Test Ø - Basic I/O
1	Test 1 - Manual Control
2	Test 2 - Paper Handling and Cyclic Print
3	Test 3 - Illegal Operations
4	Test 4 - Alignment
5	Test 5 - Operator Design*
6 thru 15	Reserved

If user selection is not requested (Switch Register bit 9 is not set) the program will execute all standard tests (Tests Ø through 4).

If user selection is requested (Switch Register bit 9 is set) and bits Ø through 4 of the A-register are cleared, all standard tests will be executed. If one or several bits of the A-register (not including bits 6 through 15) are selected only the appropriate tests will be executed. Bits 6 thru 15 are disregarded. If any of these are selected the program defaults to run the standard sequence (Tests Ø thru 4).

*Operator Design is not included in the default tests and must be selected by the operator to have the test run.

3-6.   RESTARTING

The diagnostic may be restarted by setting the P-register to 2000 (octal) and proceeding from paragraph 3-4. To restart and reconfigure, proceed from paragraph 3-3.

If a trap cell halt occurs (106077 octal) the user must determine the cause of the interrupt or transfer of control to the location in the M-register. The program may need to be reloaded to continue.

Section IV

DIAGNOSTIC PERFORMANCE

4-1. TEST DESCRIPTION

Tests 0 through 5 are described below. Refer to table 4-2 (comments on halt codes) for additional details on the content of each test. Printer operation timing allowances are discussed immediately after the information on the Alignment section. The Operator Design section is mentioned briefly here and fully described in appendix A.

4-2. BASIC I/O TEST 0

Note that there are seven subtests in Test 0, as follows.

Subtest 1 - Checks the ability to clear, set, and test the interrupt system. The following instruction combinations are tested:

CLF 0 - SFC 0
CLF 0 - SFS 0
STF 0 - SFC 0
STF 0 - SFS 0

Errors in the above sequences produce error messages E000 through E003 as shown in table 4-2.

Subtest 2 - Checks the ability to clear, set and test the interface flag. The following instruction combinations are tested:

CLF CH - SFC CH
CLF CH - SFS CH
STF CH - SFC CH
STF CH - SFS CH

Errors in the above sequences produce error messages E005 through E010 as shown in table 4-2.

Subtest 3 — Checks that the test select code does not cause an interrupt with the flag and control set on the interface and the interrupt system off. The sequence of instructions is shown below:

```
STF Ø
STF CH
STC CH
CLF Ø
```

The CLF Ø instruction should inhibit an interrupt from occurring from the interface. Error message E004 occurs if CLF Ø fails.

Subtest 4 — Checks that the flag of the interface under test is not set when all other select code flags are set. Error message E011 occurs if a flag is set incorrectly.

Subtest 5 — Checks the ability of the interface to interrupt. With the flag and control set and the interrupt system on, the interface should interrupt. If the interrupt is missing error message E014 occurs.

Checks that the interrupt occurred where expected. The interrupt should not occur before a string of priority-affecting instructions are executed. The following instructions are used to check the hold off operation:

```
STC 1
STF 1
CLC 1
CLF 1
JMP *+1,I
DEF *+1
JSB *+1,I
DEF *+1
NOP
```

Error messages E012 and/or E015 will occur if the hold off failed. If a second interrupt is encountered after the interrupt system has been turned back on error message E013 will occur.

Checks that no instruction was missed during the interrupt (E026 INT EXECUTION error).

Subtest 6 - Checks that with the interrupt system on and the CH control and flag set, there is no interrupt following a CLC CH instruction. The following sequence of instructions are used:

```
STC CH
STF CH
STF Ø
CLC CH
```

If the CLC CH fails to inhibit an interrupt, error message E016 will occur.

Checks that the CLC Ø instruction inhibits interrupts when the CH control and flag are set. The following sequence of instructions is used.

```
CLF CH
STC CH
STF CH
STF Ø
CLC Ø
```

If the CLC Ø fails to inhibit an interrupt, error message E017 will occur.

Subtest 7 - Checks that the PRESET (EXTERNAL and INTERNAL if applicable) switch(es) on the operator panel performs the following actions:

Sets the interface flag (EXTERNAL). Clears interface control (EXTERNAL). Turns off the interrupt system (INTERNAL).

Clears the I/O data lines (EXTERNAL).

4-3. MANUAL CONTROL TEST 1

This section allows the operator to test various line printer functions and to insure that the proper status is reported. The following operations are performed:

Tests MASTER CLEAR switch (should clear character count and reset zone count).

Tests power-down and power-up sequence.

Tests ON-LINE switch.

Verifies form feed and manual top-of-form alignment. The program issues a form feed and prints "TOP OF FORM --COMPUTER". The program next issues 59 linefeeds and prints "PERFORATION STEP OVER-COMPUTER". The program requests the operator to toggle the TOP OF FORM switch, then prints "TOP OF FORM - MANUAL". It issues 54 linefeeds; requests the operator to toggle the PAPER-STEP switch 5 times, and prints "PERFORATION STEP OVER-MANUAL". The operator should verify that each printed line appears in the same relative position on each page.

4-4. PAPER HANDLING AND CYCLIC PATTERN TEST 2

This section tests the paper handling operations and causes the line printer to print cyclic patterns in the following manner:

Perform an initial status check, and issue a form feed.

Print a cyclic pattern with single line feed for sixty lines of twenty characters each.

Print a cyclic pattern with single line feed for sixty lines of forty characters each.

Print a cyclic pattern with single line feed for sixty lines of sixty characters each.

Print a cyclic pattern with single line feed for sixty lines of eighty characters each.

Print eighty columns of cyclic pattern from right to left. Each print buffer is made up of one character of the pattern and the rest is blank. A total of eighty prints are performed. This tests carriage return. (Will appear on the top of the next page.)

Issue three line feeds for separation.

Print eighty lines of decreasing character count. The
first line prints eighty columns of 137B (in ASCII).
The following line is truncated at the right side by
one character.

4-5. ILLEGAL OPERATIONS TEST 3

This section attempts to find worst case timing problems and
tries various illegal operations as follows:

Perform a status check, and issue a form feed.

Choosing the first character randomly, and a number of
characters randomly, print consecutive characters (as
arranged on the print drum) sixty times.

Attempt to print all ASCII codes which are not printing
characters. The character for blank (which is
non-printing) or printer commands are not used.

Print 82 characters. The first two are blank, the next
80 are the character Z. This checks the over print
capability.

4-6. ALIGNMENT TEST 4

This section prints blocks of characters to allow proper line
printer alignment as follows:

Perform a status check, and issue a form feed.

Print sixty lines. Each line contains eighty columns
of the character M. This is useful for horizontal
alignment.

Print sixty lines. Each line contains eighty columns
of the character E. This is useful for vertical
alignment and quality check.

Print sixty-four lines. Each line contains eighty
columns, one line for each character.

4-7.   OPERATOR DESIGN TEST 5

The Operator Design section aids the operator in isolating a problem to the component level. It allows the operator to design special tests for looping on one given area or to exercise a specific area found in error by other sections of the diagnostic.

4-8.   PRINTER OPERATION TIME ALLOWANCES

All printer operation timing allowances are governed by the previous output (except for form feed). The allowances are as follows:

One millisecond is allowed for character output. On the twentieth character the allowance for the previous command is used, and the next output is allowed 40 milliseconds. This allows the printer time to print the zone.

Carriage return allows 40 milliseconds for the next output and resets the zone count.

Line feed - If no perforation step-over occurs, 80 milliseconds is allowed for next output.

If perforation step-over occurs, it is the previous output time plus 90 milliseconds for the current output and then an additional 90 milliseconds is set for the next output.

Form feed - Previous output delay plus 780 milliseconds and allow 40 milliseconds plus 13 milliseconds for each line skipped for the next operation (resets line count and zone count).

4-9. ERROR INFORMATION MESSAGE/HALT CODES

A halt code summary appears in table 4-1. Error information messages and halt code meanings appear in table 4-2.

Table 4-1. Halt Code Summary

HALT	MEANING
TESTS Ø (OCTAL) THRU 5 (OCTAL)	
I02000 thru I02041	Error (E) or information (H) messages ØØ thru 41 (octal).
CONTROL	
I02073	Select code input error.
I02074	Select code input complete.
I02075	User selection request.
I02076	End of Test (A-register contains test number).
I02077	End of diagnostic run.
I06077	Trap cell halt in locations 2 thru 77 (octal).

Table 4-2. Error and Information Messages and Halt Codes

HALT CODE	PROGRAM SECTION	MESSAGE	COMMENTS
102073	Config-uration	None	I/O select code entered at configuration is invalid. Must be greater than 7 (octal). Reenter a valid select code and press RUN.
102074	Config-uration	None	Select code entered during configuration is valid. Enter program option bits in Switch Register and press RUN.
102075	Test Control	None	Test selection request resulting from Switch Register bit 9 being set. Enter the desired group of tests to be executed in the A-register then press RUN.
102076	Test Control	None	End of test halt resulting from Switch Register bit 15 being set (A-register equals test number). To continue press RUN.
102077	Test Control	PASS XXXXXX	Diagnostic run complete. (A-register value equals pass count.) Register options may be changed. To continue, press RUN.
106077	Test Control	None	Halt stored in locations 2 through 77 (octal) to trap interrupts which may occur unexpectedly because of hardware malfunctions. M-register contains the I/O slot number of interrupt. Diagnostic may be partially destroyed if halt occurs. The program may have to be reloaded; the problem should be corrected before proceeding.

Table 4-2. Error and Information Messages and Halt Codes
(Continued)

HALT CODE	PROGRAM SECTION	MESSAGE	COMMENTS
None	Test Control	2767 L.P. DIAGNOSTIC	Introductory message.
None	Test Control	TEST XX	Information message before error message (XX equals test number). Message occurs only once within a test and is suppressed for any subsequent messages within the same test.
102000	Test 0	E000 CLF 0 -SFC 0 ERROR	CLF/SFC 0 combination failed. CLF did not clear flag or SFC caused no skip with flag clear.
102001	Test 0	E001 CLF 0 -SFS 0 ERROR	CLF/SFS 0 combination failed. CLF did not clear flag or SFS caused skip with flag clear.
102002	Test 0	E002 STF 0-SFC 0 ERROR	STF/SFC 0 combination failed. STF did not set flag or SFC caused skip with flag set.
102003	Test 0	E003 STF 0-SFS 0 ERROR	STF/SFS 0 combination failed. STF did not set flag or SFS caused no skip with flag set.
102004	Test 0	E004 CLF 0 DID NOT INHIBIT INT	With card flag and control set, CLF 0 did not turn off interrupt system.
102005	Test 0	E005 CLF CH -SFC CH ERROR	CLF/SFC CH combination failed. CLF did not clear flag or SFC caused no skip with flag clear.
102006	Test 0	E006 CLF CH -SFS CH ERROR	CLF/SFS CH combination failed. CLF did not clear flag or SFS caused skip with flag clear.

Table 4-2. Error and Information Messages and Halt Codes
(Continued)

HALT CODE	PROGRAM SECTION	MESSAGE	COMMENTS
102007	Test 0	E007 STF CH-SFC CH ERROR	STF/SFC CH combination failed. STF did not set flag or SFC caused skip with flag set.
102010	Test 0	E010 STF CH-SFS CH ERROR	STF/SFS CH combination failed. STF did not set flag or SFS caused no skip with flag set.
102011	Test 0	E011 STF XX SET CARD FLAG	Select code screen test failed. A-register equals XX (octal). XX equals select code that caused card flag to set.
102012	Test 0	E012 INT DURING HOLD OFF INSTR	Interrupt occurred during an I/O instruction or a JMP/JSB indirect instruction.
102013	Test 0	E013 SECOND INT OCCURED	Card interrupted a second time after initial interrupt was processed.
102014	Test 0	E014 NO INT	No interrupt occurred with card flag and control set and the interrupt system on.
102015	Test 0	E015 INT RTN ADDR ERROR	Interrupt did not occur at the correct location in memory.
102016	Test 0	E016 CLC CH ERROR	CLC CH did not clear card control with the interrupt system on.
102017	Test 0	E017 CLC 0 ERROR	CLC 0 did not clear the card control with the interrupt system on.
102020	Test 0	E020 PRESET (EXT) DID NOT SET FLAG	PRESET (EXT) did not set the card flag.

Table 4-2. Error and Information Messages and Halt Codes
(Continued)

HALT CODE	PROGRAM SECTION	MESSAGE	COMMENTS
102021	Test 0	E021 PRESET (INT) DID NOT DISABLE INTS	PRESET (INT) did not disable the interrupt system.
102022	Test 0	E022 PRESET (EXT) DID NOT CLEAR CONTROL	PRESET (EXT) did not clear control.
102023	Test 0	E023 PRESET (EXT) DID NOT CLEAR I/O LINES	PRESET (EXT) did not clear I/O data lines.
102024	Test 0	H024 PRESS PRESET (EXT & INT), RUN	Press PRESET (EXTERNAL/ INTERNAL) then RUN.
None	Test 0	H025 BI-O COMP	Basic I/O tests completed.
102026	Test 0	E026 INT EXECUTION ERROR	Interrupt was not processed correctly.
102030	Tests 1 thru 5	E030 L.P. TIME OUT	The line printer was not ready for more data within the alloted time. The A-register equals the Current Output (CO) and the B-register equals the Previous Output (PO). May be followed by E031 if printer is off-line.
102031	Tests 1 thru 5	E031 L.P. NOT READY	The line printer was found not ready prior to an attempt to output data. The A-register equals the status input when found not ready.
102032	Test 1	E032 INCORRECT STATUS	During a status checking sequence the status from the line printer was incorrect. The A-register equals Current Status (CS) and the B-register equals the Expected Status (EX).

Table 4-2.   Error and Information Messages and Halt Codes
(Continued)

HALT CODE	PROGRAM SECTION	MESSAGE	COMMENTS
102033	Test 1	H033 PUT L.P. ON-LINE	Operator should ensure that the line printer is ready and on line.
102034	Test 1	H034 MASTER CLEAR L.P.	The MASTER CLEAR switch is on the line printer maintenance panel inside the front door.
102035	Test 1	H035 TURN OFF L.P. POWER	POWER switch is on the maintenance panel.
102036	Test 1	H036 TURN ON L.P. POWER	POWER switch is on the maintenance panel. DO NOT WAIT FOR READY!
102037	Test 1	E037 NO READY RESPONSE	Ready status has not occurred within 1 minute after turning on power.
102040	Test 1	H040 PUT L.P. OFF-LINE TOGGLE TOP-OF-FORM SWITCH	Switches are on the line printer control panel.
102041	Test 1	H041 PUT L.P. OFF-LINE TOGGLE PAPER STEP 5 TIMES	Switches are on the line printer control panel.

NOTE: Test numbers and error halt codes are in octal.

Appendix A

OPERATOR DESIGN

INTRODUCTION

The Operator Design section of the diagnostic consists of a command processor, source statement file, a source statement translator, and a user buffer. The command processor accepts command inputs from the operator, and using these commands, listed in table A-1, causes the diagnostic to perform the appropriate action. The source statement file is composed by the operator using source statements listed in table A-2. The file will be executed, on command from the operator, by the source statement translator. The source statement translator calls a subroutine specified by the source statement file and passes any required parameters provided by the operator. The user buffer is composed by the operator and is used by the subroutine during execution of source statements.

It should be noted that the source statement file and user buffer are cleared upon entry into Operator Design. If the operator wishes to run a diagnostic test, while in Operator Design (Opdesign), he should use the "NN TEST X" statement. Operating procedures, error reporting information, lists of commands and source statements, and an example of an Operator Design program follow.

OPERATING PROCEDURE

To enter Operator Design, the operator must select test 5 (reference section III, Test Selection). Operator Design is not a standard test and therefore is not entered when the standard set is used.

The message "OPDSN" is printed when Opdesign is entered. This is followed by the "@" symbol indicating the program is ready to accept inputs from the operator. The operator may then enter a command or a source statement as listed in tables A-1 and A-2. All inputs must be followed by a carriage return and line feed. If an input is found incorrect the message "INPUT ERROR" will be printed followed by the "@" symbol. If the operator notices the input error before the LINE FEED key is depressed, he may press the RUBOUT key followed by a carriage return-line feed, then enter the correct input.

To enter source statements from table A-2, the operator must enter:

A line number followed by a space. The line number (represented by NN in table A-2) must be in the range 1 to 9999.

A source statement listed in table A-2 (1 to 4 ASCII characters) followed by a space.

Any parameters required of the operator as listed in table A-2. The program allows for two parameters but a statement may use only one, or none. The parameters must be separated by a space. If the statement requires parameters and the operator does not enter them the parameters are assumed to be zero and the subroutine will default to a given set.

A carriage return-line feed.

When statements are entered they need not be in numerical order. They will be put in numerical order by the program and executed in that order.

To delete a source statement the operator must enter the line number only. That particular line will be deleted.

When the operator enters a GO command (commands are listed in table A-1) the previously entered source statements will be executed. After execution the "@" symbol is output to the teleprinter (console) to signal the operator that the program has been completed and is ready for more input.

Note: During execution the program may stop and return the "@" symbol for the following reasons:

End of source statement file.

Switch Register bit 9 was set. (Switch Register bit 9 is used to abort the GO, LF, and LB commands. The switch should be cleared after the @ symbol appears on the teleprinter.)

An "ST" was entered after a WAIT statement execution.

A STOP source statement was executed.

ERROR REPORTING

If, during execution of a source statement, an error is detected the error message routine in the Control section is used. A halt will occur if Switch Register bit 14 is not set. This requires that the operator presses RUN. If the operator wishes to abort the rest of the Opdesign section, he can then set Switch Register bit 9 and press RUN.

There are several error messages in Opdesign that can not be suppressed. They are as follows:

LINE? (LINE NN)

This means that the source statement called for a different line number to continue execution (other than the next sequencial one) and the line number was not found (GOTO, GOSB, RTN, and SC).

GS OV (LINE NN)

More than 15 GOSB source statements have stacked up without being cleared by a RTN source statement.

QUEUE FULL

The area allocated to source statements has been filled and the source statement just entered was not put in the file. Some source statements must be deleted from the file before any new ones may be added.

COMMANDS

The following commands may be used while running the Operator Design section. They are explained in detail in table A-2.

LF   List source statement file. (Also command LFP.)

LB   List user buffer. (Also command LBP.)

CF   Clear source statement file.

CB   Clear user buffer.

DB   Define buffer.

GO   Execute user program (source file). (Also command GOT.)

BY   Exit Operator Design.

A-3

Table A-1. Operator Design Commands

COMMAND	MEANING AND DESCRIPTION
LF or LFP	List Source Statement File. When the LF command is entered, the diagnostic will list the source statement file. The list will be in numerical order when output to the teleprinter. The list command (LF) can be aborted by setting Switch Register bit 9. The switch must be cleared after the @ symbol is output to the teleprinter console. The LFP (Line Printer) Command is used to list on a line printer. It should be used only on a line printer other than the one under test.
LB or LBP	List User Buffer. When the LB command is entered the diagnostic will list the user buffer in sequence. The sequencial number is enclosed in parenthesis and followed by the buffer contents. The contents are in octal format regardless of the data format input. The list command (LB) can be aborted by setting Switch Register bit 9. The switch must be cleared after the @ symbol is output to the teleprinter console. The LB command may be followed by two numbers. The first is the starting number for the list and the second, the last number to be listed. If the last number is not input, only one buffer location will be listed. The LBP (Line Printer) command is used to output the list on a line printer. The command should be used only for a line printer other than the one under test.
CF	Clear Source Statement File. To clear all of the source statements enter "CF".

Table A-1. Operator Design Commands (Continued)

COMMAND	MEANING AND DESCRIPTION
CB	**Clear User Buffer.** When the CB command is entered the program will clear the buffer count which means there is no data in the buffer. The CB command may be followed by two numbers. These are to be used to delete sections of the buffer. If only one number is supplied, only that buffer location will be deleted.
DB	**Define Buffer.** This command must be followed by: "IA" Insert ASCII (DBIA) "IK" Insert octal (DBIK) "RA" Replace with ASCII (DBRA) "RK" Replace with octal (DBRK) plus any parameters then terminated by a carriage return-line feed. If only "DB" is entered, or if only DB is entered followed by a space, the program will only output the current buffer count to the teleprinter. If no number is supplied when using the Insert command, (DBIA DBIK) the input data will be appended to the end of the buffer. If a number is supplied, the input data will be inserted after the location specified. One or two numbers must be supplied when using the replace command (DBRA DBRK). The first number is the starting location and the second, the last location of the area to be replaced. IF only one number is supplied only that location will be replaced. When using the Replace command, the input data can be greater or less than the number being replaced. When inputting data, the "A" or "K" specifies the conversion type.

Table A-1. Operator Design Commands (Continued)

COMMAND	MEANING AND DESCRIPTION
	If "A" is specified, the input that follows is placed in the user buffer in unpacked format. Each character is one location. If "K" is specified, the input that follows is converted and placed in the user buffer. The octal input will accept a string of octal numbers separated by a space. The operator can enter a packed ASCII string by specifying octal then input pairs of ASCII characters separated by a space. If more than two characters are together between spaces, only the first two will be used. When input is complete (carriage return-line feed) or 72 characters are entered, the diagnostic will output the message, "DONE?" If the input is not complete enter "NO" and continue with input. If input is complete, enter "YE" and the current buffer count will be output followed by the @ symbol.
GO or GOT	Execute User Program. The GO command will start execution of the source statement file. The execution will start at the first line number. Execution can be terminated by setting Switch Register bit 9. The switch must be cleared after the @ symbol is output to the teleprinter. The GOT command will enable the computer to make timing checks on the line printer subsystem. The computer (through the diagnostic) will check for the line printer ready state. If the line printer subsystem is ready, the diagnostic will issue a form feed to initialize timing. If this command is not used a maximum time of two seconds is used for all outputs.

Table A-1.   Operator Design Commands (Continued)

COMMAND	MEANING AND DESCRIPTION
BY	Exit Operator Design. This command will terminate Operator Design and return to the Control section.

SOURCE STATEMENTS

All source statements must be preceded by a number. If the same source statement number is entered the last one entered is the one in the file.

This procedure allows the operator to change a source statement without deleting the current source statement. A summary of the source statements follows. Detailed explanations of the source statements are in table A-2. (NN represents a source statement number.)

Program control source statements:

NN GOTO X	Go to line X.
NN GOSB X Y	Go to subroutine starting at line X and repeat it Y number of times.
NN RTN	Return to the last GOSB line number +1 (if the GOSB repeat count is 0).
NN WAIT	Wait for operator.
NN MSG X	Output "*X" on the console (where X equals any two alphabetic characters).
NN DLY X	Delay further execution by X number of milliseconds.
NN TEST X	Execute test number X (where X is an octal number).
NN STOP	Terminate execution of Operator Design.

Peripheral (line printer) control source statements:

NN SR		Status report of line printer.
NN SC X Y		Status check of line printer with X (octal). If not the same go to line Y (integer).
NN CP X Y		Cyclic print X number of characters and number of lines specified by Y.
NN OC X Y		Output character specified by X and number of character(s) specified by Y.
NN CR		Output a carriage return to line printer.
NN LF		Output a line feed to the line printer.
NN FF		Output form feed to the line printer.

Table A-2.   Operator Design Source Statements

SOURCE STATEMENT	MEANING AND DESCRIPTION
GOTO	Go to line X. When executed, the GOTO statement tells the source statement translator to continue execution at line X as specified by the operator. The line number entered by the operator must be a decimal number. That line number must exist in the source statement file. When executed if the line specified does not exist, the message LINE? (LINE NN) will be output to the teleprinter followed by the @ symbol. All execution stops at this point.
GOSB	Go to subroutine. This is used to execute a section of the source statement file that is used several times during execution. The first number (see the summary) after the source statement specifies the starting line number. Like the GOTO source statement, if the line does not exist the diagnostic reports an error and stops. The second number (see the summary) specifies the number of times the program must execute the source statements. This number may be omitted when entering the GOSB. If it is omitted, the routine will be executed only once. The section of the file that is executed must be terminated by a RTN. If more than 15 GOSB source statements are encountered before a RTN the 16th GOSB will be considered an error. The following message will be printed and the source statement translator will stop executing. GS OV (LINE NN)

Table A-2. Operator Design Source Statements (Continued)

SOURCE STATEMENT	MEANING AND DESCRIPTION
RTN	Return to last GOSOB +1. This source statement is used to terminate a section of code that is used as a subroutine. It is used with the GOSB source statement. If a RTN is encountered prior to any GOSB source statements , the message "LINE? (LINE NN)" will be output to the teleprinter and execution will stop because there is no line number to return to.
WAIT	Wait for operator. When the program executes a wait statement it outputs to the console: "WAIT (LINE NN)" to inform the operator of the wait and of where it is in the program. The operator must enter on the teleprinter either "CO" for continue execution, or "ST" to stop further execution. The state of the program is not changed. If CO is entered, all GOSB's are maintained. This is useful when the operator wishes to change something manually and wants the program to wait for him.
MSG	Message. When executed, the program will output "*AA" to the teleprinter. The AA may be any two ASCII characters entered when the MSG statement is entered. This is used by the operator to indicate the portion of the program that is executing.

Table A-2. Operator Design Source Statements (Continued)

SOURCE STATEMENT	MEANING AND DESCRIPTION
DLY	Delay. This is used to delay further execution of the program. The minimum delay is 1 millisecond. The maximum delay is 32,768 milliseconds. If Ø is entered, the delay will be ignored.
TEST	Execute test number X. This is used to execute one of the standard tests listed for the diagnostic. If a test number greater than the Operator Design test number (test 5) is entered, it is ignored. If the test number is equal to Opdesign (Test 5) a stop will occur.
STOP	Terminate execution (STOP). When this source statement is executed the program will stop source statement execution and output the message "STOP (LINE NN)", then the @ symbol. This indicates Opdesign is ready for operator inputs.
SR	Status Report. When executed, the program loads a 16-bit word from the line printer channel and outputs it in octal in the message "L.P. STATUS IS XXXXX (LINE NN)". This is used by the operator as troubleshooting information.
SC	Status Check. This source statement will load a 16-bit word from the line printer channel and compare it with the first parameter following the SC statement entered by the operator. If the two compare, no action is

Table A-2. Operator Design Source Statements (Continued)

SOURCE STATEMENT	MEANING AND DESCRIPTION
	taken and the next line in sequence is executed. If the two do not compare the program continues execution at the line number specified by the second number entered by the operator. (See the source statement summary). If the line number does not exist the program will output "LINE? (LINE NN)" and stop.
CP	Cylic Print. The CP source statement will output a cyclic pattern of characters (ripple print). The number of characters per line is specified by the first parameter after the CP. The number of lines is specified by the second parameter. (See the source statement summary). The default case is 80 characters per line and 60 lines.
OC	Output Characters. This source statement (OC) will output characters to the line printer; either a single character or the characters from the user buffer. The first parameter specifies a character by $A (where A can be any ASCII character) or UB (meaning user buffer). The second number (see the summary) specifies the number of characters to be output. In the case of a single character ($) the maximum number is 32,767. For user buffer (UB), the number can not be greater than the count in the user buffer. If the count is not supplied the test defaults to 1 for one character or buffer length for user buffer.
CR,LF,FF	Carriage Return, Line Feed, Form Feed. These source statements will output only one byte to the printer. Each represents its function: CR=Carriage Return (15 octal), LF= Line Feed (12 octal) and FF= Form Feed (14 octal).

OPERATOR DESIGN EXAMPLE TEST

The following is an example of a simple source statement file to check line feed and form feed.

@12 GOSB 100 67   (Go to subroutine 100, 67 times).

@14 FF   (Issue another form feed.)

@160 STOP   (Stop program execution).

@100 OC $A 53   (Output the letter A 53 times).

@102 LF   (Issue a line feed).

@104 RTN   (Return to gosub line +1).

@LF   (List statement file).

0012 GOSB 00100 0067

0014 FF

0016 STOP

0100 OC $A 00053

0102 LF

0104 RTN

@ GOT   (Execute above program with timing checks).

At this point the line printer will check for the ready status (GOT) and issue a form feed to set timing, then output 67 lines of 53 character A's.